

# **Determining "Ground Truth" in the New Jersey STRATAFORM Natural Laboratory**

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## **LONG-TERM GOALS**

Understand the creation of preserved stratigraphy along continental terraces, by linking sedimentation processes to preserved sequence stratigraphy and facies architecture.

## **OBJECTIVES**

As part of STRATAFORM, the University of Texas Institute for Geophysics (UTIG) and collaborators are continuing to integrate "nested" seismic data available off New Jersey with subsurface samples of various kinds, as they become available. This primary STRATAFORM goal remains elusive off New Jersey, because "ground-truthing" of seismic sequence boundaries and intervening facies by sampling at all relevant depths is as yet incomplete. The objectives are: 1) to study the history of sea-level change over the past ~35 Ma, and 2) to determine the effects of various depositional and erosional processes on the preserved continental margin sediment record, from the seafloor to subbottom depths of ~100 m.

## **APPROACH**

**Task 1: a) integrate regional high-resolution MCS with ODP cores and downhole logs and b) correlate Huntec 2D/3D and chirp sonar control with grab samples and vibra-cores (STRATAFORM tasks C1, C4, C5)**

- Finish interpreting high-resolution MCS profiles collected for STRATAFORM in 1995 in the context of Ocean Drilling Program (ODP) Leg 174A drilling results and existing MCS interpretations on the shelf and upper slope (Fulthorpe, Austin, Olson).
- Link outer shelf and upper slope stratigraphic regimes, by tying ODP Leg 174A and Leg 150 results seismically, in order to understand source-to-sink sediment dispersal systems (Fulthorpe, Austin).

**Task 2: calibrate shallow subsurface seismic stratigraphy, in order to assess the preservation potential of the New Jersey shelf succession (STRATAFORM tasks C2, C4, C5, C6c)**

- Ascribe physical significance to existing 2D and 3D seismic images of surficial seismic stratigraphy through analysis of core samples (Austin, Fulthorpe, Olson, Duncan).
- Investigate the apparent lack of coherence between the modern sea floor and the shallowest subsurface (Goff, Olson, Duncan).

## WORK COMPLETED

Analysis and integration of results from Leg 174A, conducted in June-July 1997, are being completed; at UTIG, the analysis and integration has been led by Fulthorpe with help from Austin. The Leg 174A Scientific Results volume will be available in 2001 on the WWW at <http://www-odp.tamu.edu/publications/>.

Since UTIG collected its first 3D Hunttec data on the New Jersey shelf in 1989, a primary objective has been ground-truthing resultant ultra-high resolution images. Short piston cores were acquired after the 1989 survey; a suite of vibra-cores was collected in association with the second 3D survey in 1993. A test of the *Marion Dufresne*-based CALYPSO corer took place in June 1999; shelf penetrations in the vicinity of the 1989 3D survey were either completely unsuccessful or did not greatly exceed the ~5 m vibra-cores recovered in 1993 (and this recovery may have been flow-in). Nonetheless, studies of CALYPSO cores continue (Olson). PROD ("Portable Remotely Operated Drill") coring (to subbottom depths of 30 m) was tentatively planned to take place in the summer of 2000. In preparation for that work, testing of the PROD took place in two phases: in December 1999 in Pittwater estuary, New South Wales, Australia, and in March 2000, in Puget Sound. Austin participated in both of those tests. After those tests, a determination was made not to use PROD for New Jersey operations until additional engineering/design modifications on that system have been completed.

A comprehensive geological/geophysical characterization of the uppermost middle-outer New Jersey shelf is also underway, building upon multi-beam backscatter/bathymetric imaging of the seafloor and 2D/3D ultra-high resolution geophysical control collected in accordance with **Tasks C2 and C5**. Surficial sediment (grab-) sampling efforts, along with chirp and sidescan-sonar surveys, have been led by Goff at UTIG, with support from Olson, Austin, Duncan, and others. Duncan continues her Ph.D. dissertation on the stratigraphic relationships among Hunttec 2D/3D control, chirp sonar data, and both grab samples and short (up to ~5 m) vibra-cores collected on the middle-outer shelf in 1993 (Duncan et al., in press); Duncan will defend her Ph.D. in early 2001.

## RESULTS

Isopach/structure maps of Miocene to Pleistocene shelf sequence boundaries and downlap surfaces (indicators of maximum flooding) beneath the New Jersey shelf and upper slope are beginning to illustrate the sediment distribution through time (Austin, Christie-Blick, Malone et al., 1998). Such mapping is the focus of **Task C1**, which mandated contouring thicknesses and describing facies of mid-shelf to upper slope sequences. Understanding these shelf/slope systems is the ultimate objective of **Task C4**, which mandated that "high-resolution" 2D MCS control be acquired, analyzed and interpreted across the shelf-slope break. Fulthorpe et al. (1999) have shown that rivers discharged near the paleo-shelf edge during some Miocene sea-level lowstands. However, slope canyons probably formed independently of such fluvial systems. Although such canyons did form during lowstands, their presence appears to have been controlled by local conditions (e.g., efficiency of sediment transport, rate of sediment supply, grain size, spring-sapping?) other than sea level (Fulthorpe et al., 2000).

As a result of studies completed since the first vibra-cores were collected in 1993, we now know that the surficial, latest Pleistocene-Holocene stratigraphy is: 1) complicated (Buck et al., 1999), and 2) not directly related to seafloor morphology (work by Goff and others, see **Tasks C2 and C5**, above). However, reworking does not extend to great depths, perhaps not more than ~0.5 m sub-sea floor. Another complexity arises from the stratigraphy associated with filled, meandering channels in the

surficial section; these have been imaged by both the 1989 and 1993 Huntect 3D surveys. Duncan et al. (in press) have developed a model relating the observed Huntect stratigraphy to depositional processes associated with the last transgression (~22-7 ka) across the New Jersey margin; this is an important part of **Task C6c**. However, the stratigraphic succession associated with these interconnected(?), coeval(?) drainage systems is as yet unexplained, because the number and length of the subsurface samples collected to date are insufficient to unravel their stratigraphic complexities.

## **IMPACT/APPLICATIONS**

The seismic coverage generated by STRATAFORM has been an important part of the Mid-Atlantic Sea Level Transect, whose long-term goal has been to understand the effects of global changes of sea level, among other forcing factors, on the formation and preservation of stratigraphy over the past ~35 Ma. The sampling being undertaken as part of this grant will eventually provide the high-resolution ground truth necessary to look in detail at the latest Pleistocene-Holocene part of the eustatic record, tie it systematically to litho- and biofacies beneath the New Jersey mid- and outer shelf, and calibrate the shallow subsurface seismic stratigraphy that has been (Duncan et al., in press) and is being developed for this margin.

## **TRANSITIONS**

PROD coring may still take place, either in summer 2001 or later. We have also begun discussions with Continental Scientific Drilling Program personnel to use the GLAD800 barge-mounted drilling system as another possible means of achieving systematic subsurface control off New Jersey. Such cores, many of which will be collected within previous Huntect 2D/3D coverage, should eventually provide the ground truth in support of another ONR research initiative off New Jersey, "Geoclutter."

## **RELATED PROJECTS**

STRATAFORM and ODP (an international program funded through NSF) have both played prominent roles in ongoing New Jersey research. STRATAFORM and Geoclutter sampling envisioned for 2001 and beyond should proceed in tandem with additional acoustic reconnaissance, including 2D and 3D chirp sonar imaging, planned for 2001 as part of Geoclutter.

## **PUBLICATIONS**

Austin, J. A., Jr., N. Christie-Blick, and M. Malone, 1998, Proc. ODP, Init. Repts., 174A. College Station, TX (Ocean Drilling Program; <http://www-odp.tamu.edu/publications>).

Buck, K. F., H. C. Olson, and J. A. Austin, Jr., 1999. Paleoenvironmental evidence for latest Pleistocene sea-level fluctuations on the New Jersey outer continental shelf: combining high-resolution sequence stratigraphy and foraminiferal analysis. *Marine Geology*, v. 154, p. 287-304.

Duncan, C. S., J. A. Goff, J. A. Austin, Jr., and C. S. Fulthorpe, in press, Tracking the last sea-level cycle: Seafloor morphology and shallow stratigraphy of the latest Quaternary New Jersey middle continental shelf. *Marine Geology*.

Fulthorpe, C. S., J. A. Austin, Jr., and G. S. Mountain, 1999, Buried fluvial channels off New Jersey: Did sea-level lowstands expose the entire shelf during the Miocene? *Geology*, v. 27, no. 3, p. 203-206.

Fulthorpe, C. S., J. A. Austin, Jr., and G. S. Mountain, 2000, Morphology and distribution of Miocene slope incisions off New Jersey: Are they diagnostic of sequence boundaries? *Geological Society of America Bulletin*, v. 112, p. 817-828.